T.E. VI Sem - Chem. LTD.

TE/VI/CBGS/Chem/CRE II

Chemical Reaction Engineering - II

(23)

Q.P. Code : 6408

(3 Hours) [Total Marks : 80

N. B. (i) Question number **one is compulsory.**
(ii) Answer any **three** questions from the rest.
(ii) Assume suitable data wherever necessary.

Q.1.a) Differentiate between Physical adsorption and Chemical adsorption. (05)

b) Differentiate between true density, apparent density and bulk density of catalyst particles. (05)

c) What are different controlling mechanisms in non catalytic heterogeneous reaction? (05)

d) What is the significance of Hatta number in fluid –fluid reactions? (05)

Q.2.a) Estimate the surface area (m2/gm) of 8.01 gm of glaucosil sample. Nitrogen at -195.8 deg C is used for adsorption studies. The adsorption data obtained are given below. (10)

Pressure (mm Hg)	6	25	140	230	285	320	430.	605
Vol. adsorbed (cc) at STP	61	127	170	197	215	230	277	335

The vapour pressure of nitrogen at -195.8 deg C is 1 atm and the density of nitrogen is 0.808 gm/cc.

b) Develop Langmuir-Hinshelwood type of rate equation for (10)

$$A+B \rightleftarrows C+D$$

When the rate of adsorption of A is rate controlling step.

Q.3) For the gas-liquid reaction of the type (20)

$$A_{(gvl)}+bB_{(l)} \rightarrow R$$

$$-r_A = kC_A C_B$$

Discuss the possibilities of various types of reaction regime and give their rate

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expressions with proper diagrams.

Q.4.a) Calculate the time needed to burn to completion particles of graphite (Ro = 5 mm, density of solid= 2.2 gm/cm^3 k"= 20 cm/sec) in an 8% oxygen stream. For the high gas velocity used assume that film resistance does not offer any resistance to transfer and reaction. Reaction temperature=900 deg C (08)

b) A solid feed consisting of (12)

20 wt% of 1-mm particles and smaller

30 wt% of 2-mm particles

50 wt% of 4-mm particles

passes through a rotating tubular reactor somewhat like a cement kiln where it reacts with gas to give a hard nonfriable solid product (SCMI reaction control, τ = 4 h for 4-mm particles).

1. Find the residence time needed for 100% conversion of solids.
2. Find the mean conversion of the solids for a residence time of 15 min.

Q.5) The RTD analysis was carried out in a liquid phase reactor as follows:- (20)

t, min	0	2.5	2.9	3.3	3.75	4.0	4.16	4.33	4.58	5	5.41	6.25	7.5
Conc gm/cc 1x10^3	0	0	1	3	7.4	9.4	9.7	9.4	8.2	5.0	2.5	0.5	0

1. What is the mean residence time?
2. What fraction of material spends between 4 & 5 min in the reactor?
3. What conversion can be expected for the reaction carried out in this reactor with a rate constant of 0.7 min^{-1} using segregation model.
4. Calculate Variance?
5. Calculate conversion using tank in series model.

Q.6) Write short note on any two: 20)

a) Bubble Column Reactor

b) Reactors for Solid Fluid Noncatalytic Reactions

c) Two Parameter Model for Nonideal reactors

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